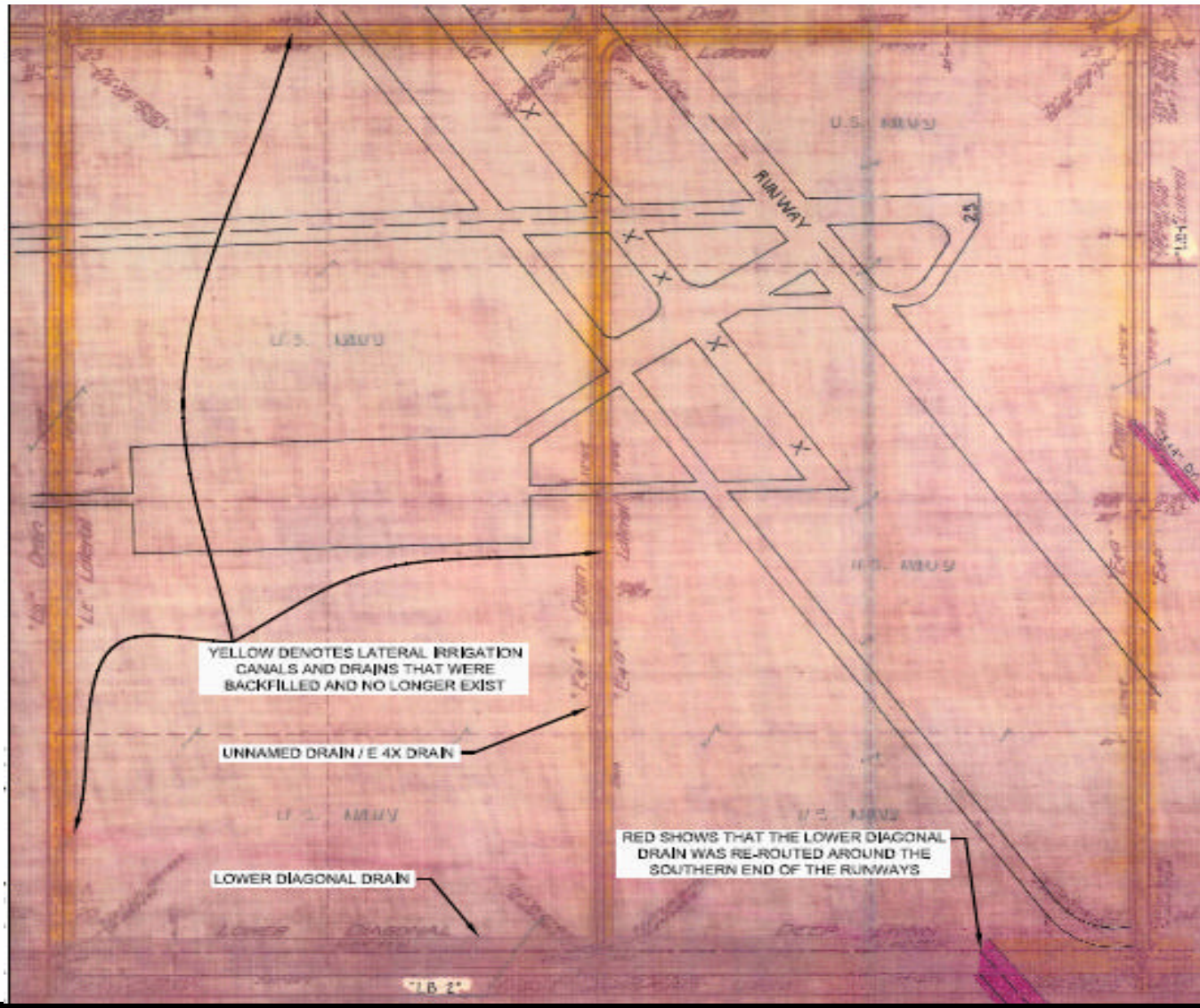
Site 16 and E4X Drain Interaction

E4X Drain History

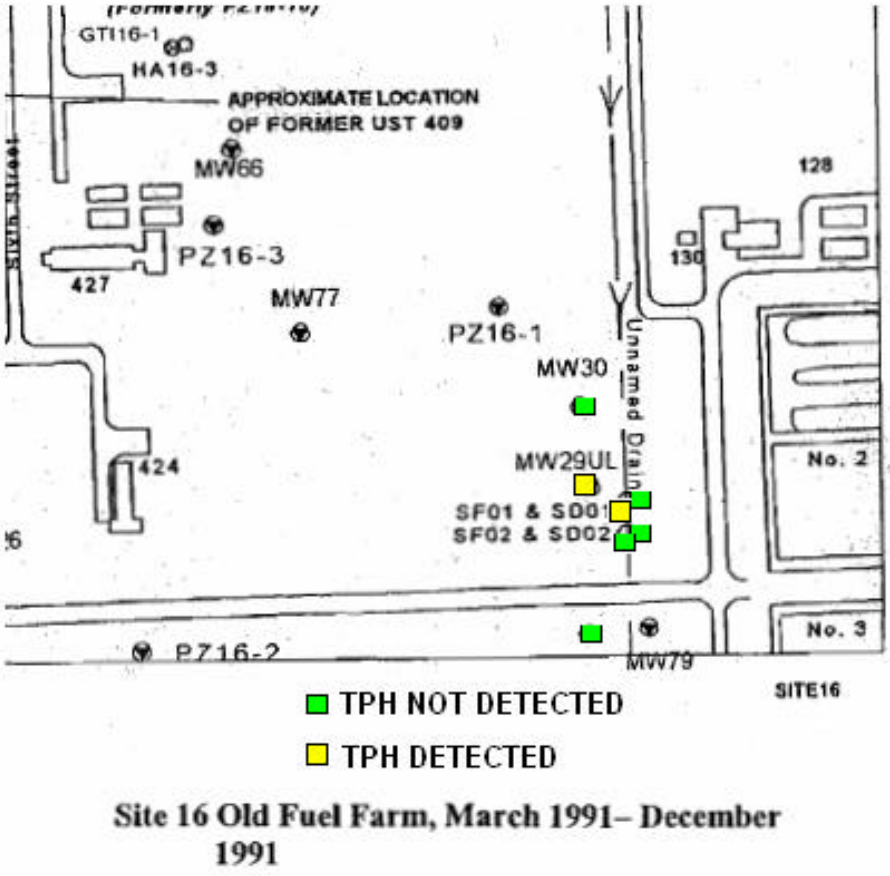
- Constructed in 1942 as irrigation return drain
- Drains were designed to intersect the water table
- All irrigation water supply canals and many of the drains were filled in during base construction



E4X Drain History

- **1991 Soil Sampling near the E4X Drain detected low levels of TPH-gasoline and TPH-diesel in two locations**

Location	TPH-gasoline (mg/kg)	TPH-diesel (mg/kg)
MW-29	8	ND
SF01	131	270



Site 16 Old Fuel Farm, March 1991– December 1991

E4X Drain History

- E4X Drain sampled annually starting in 1996
- Trihalomethane compounds routinely detected in all E4X Drain samples – likely resulting from the wastewater treatment plant that discharges to the E4X Drain
- From 1996 to spring 2003, no TPH detected
- In October 2003, addition sampling with lower detection limits detected low levels (<1 µg/L) of naphthalene, 2-methylnaphthalene, benzo(b)fluoranthene, TPH diesel (110 µg/L), and 1,4-dichlorbenzene (1.1 µg/L)
- Although none of the contaminants exceeded any action levels, the Navy preemptively implemented the Site 16 plume containment system in 2004

E4X Drain History

- In 2004, extensive sampling from several locations in the E4X Drain did not detect any TPH-diesel, but did detect cis-1,2-DCE (0.14J µg/L), toluene (0.14J µg/L)

- Sampling in 2005, 2006, and 2007 at the confluence of the E4X Drain and the Lower Diagonal Drain detected only trihalomethanes

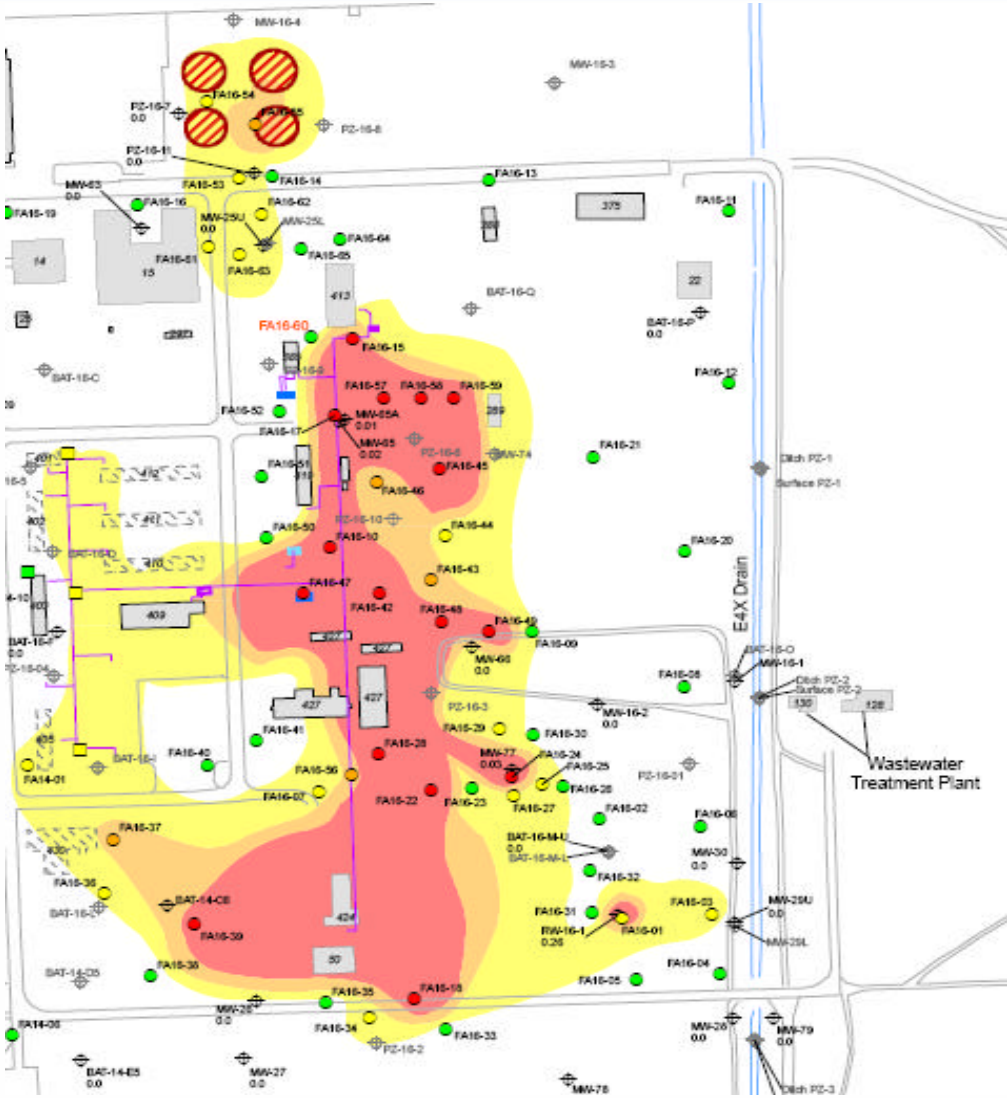
CONCLUSIONS-

- No Site 16 COCs have been detected in the E4X Drain above MCLs or Region 9 PRGs

- Detections of any Site 16 COCs in the E4X Drain have been rare and at low levels

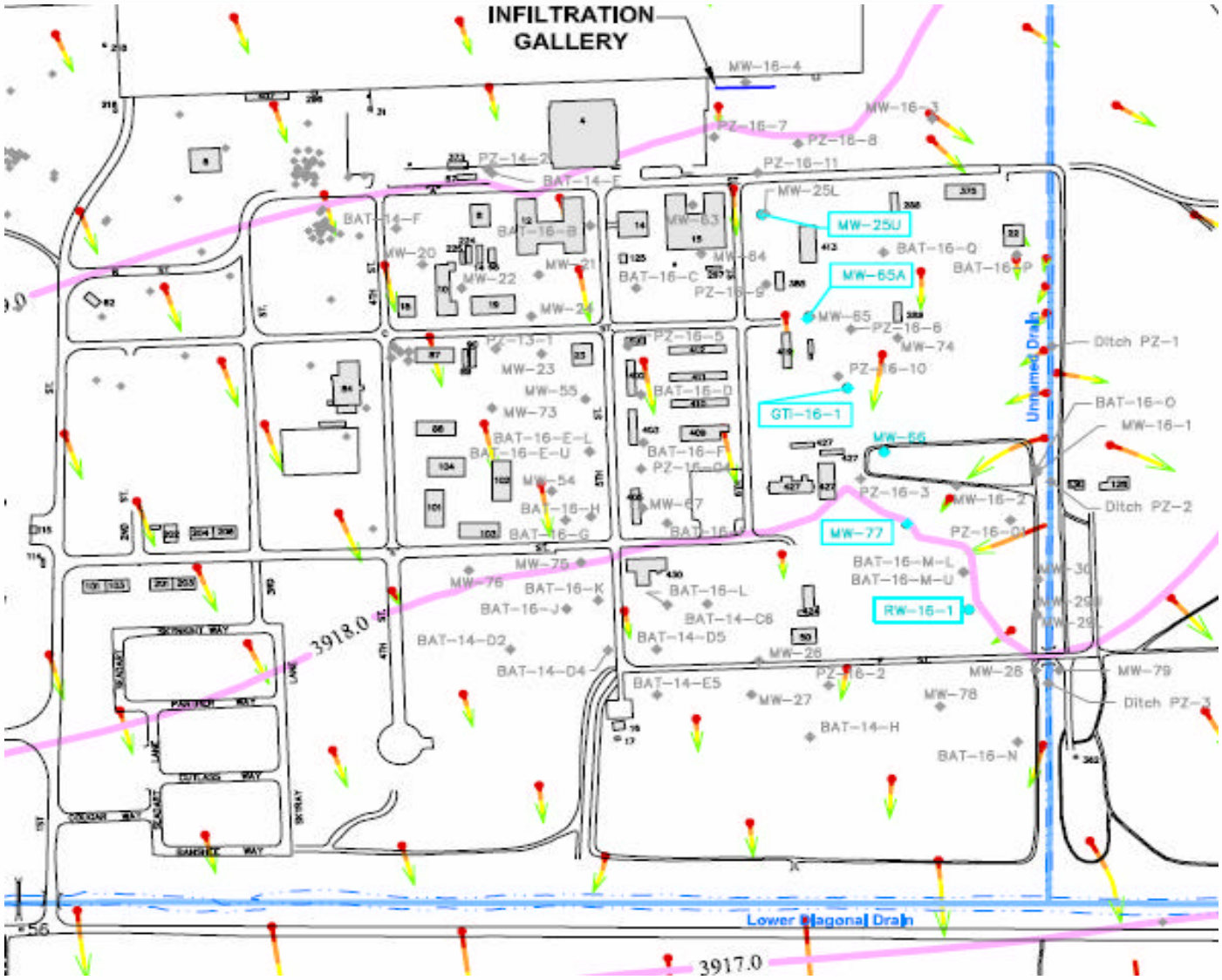
Site 16 SCAPS Results

- TPH contamination near E4X Drain is confined to southern portion of site—similar to the 1991 soil sampling results



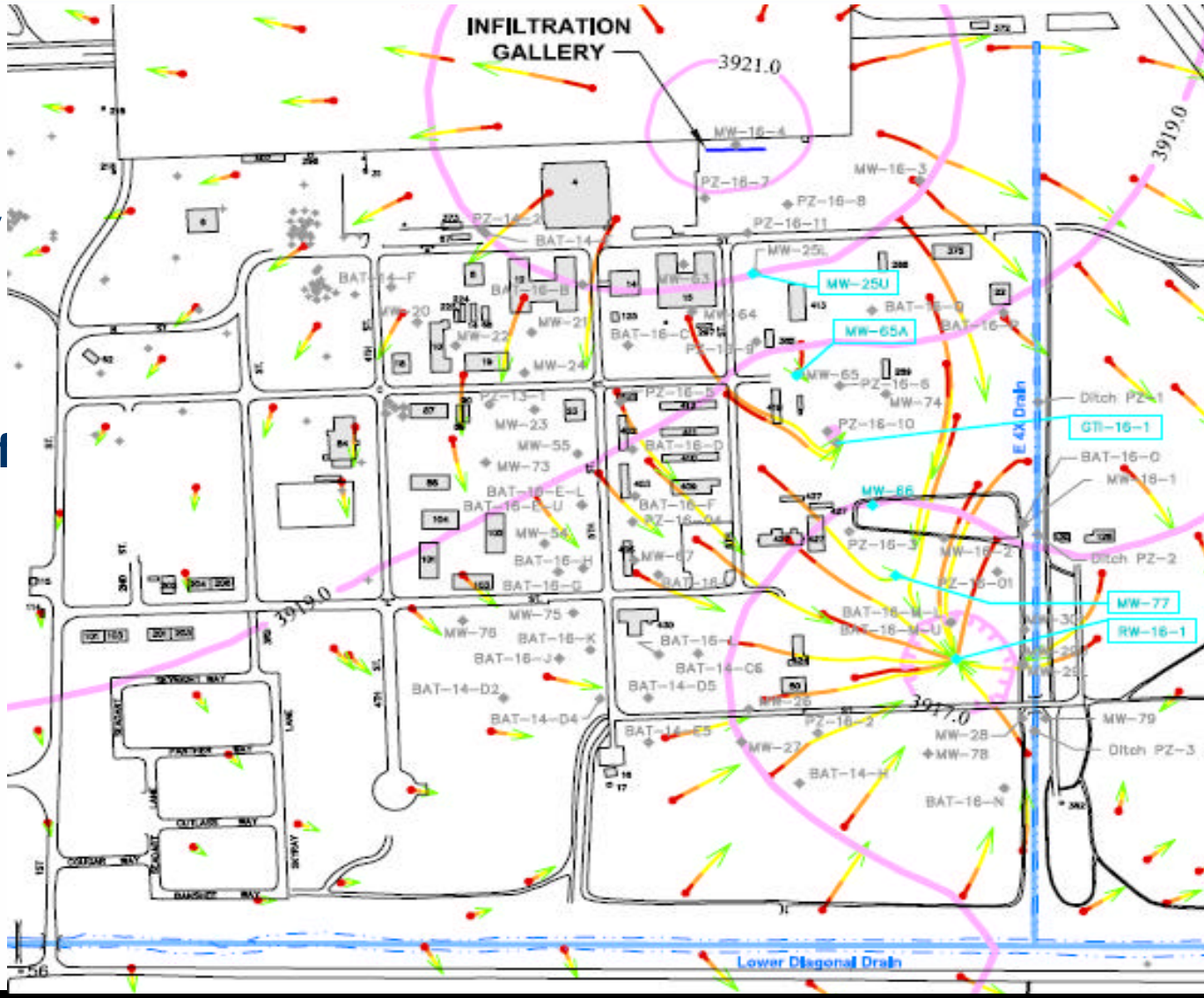
Site 16 Groundwater Flow (natural conditions – June 2004)

- Groundwater flow is generally to the south-southeast
- Groundwater velocity ranges from 6 to 16 feet per year
- Both the E4X and Lower Diagonal Drain affect groundwater flow direction and velocity



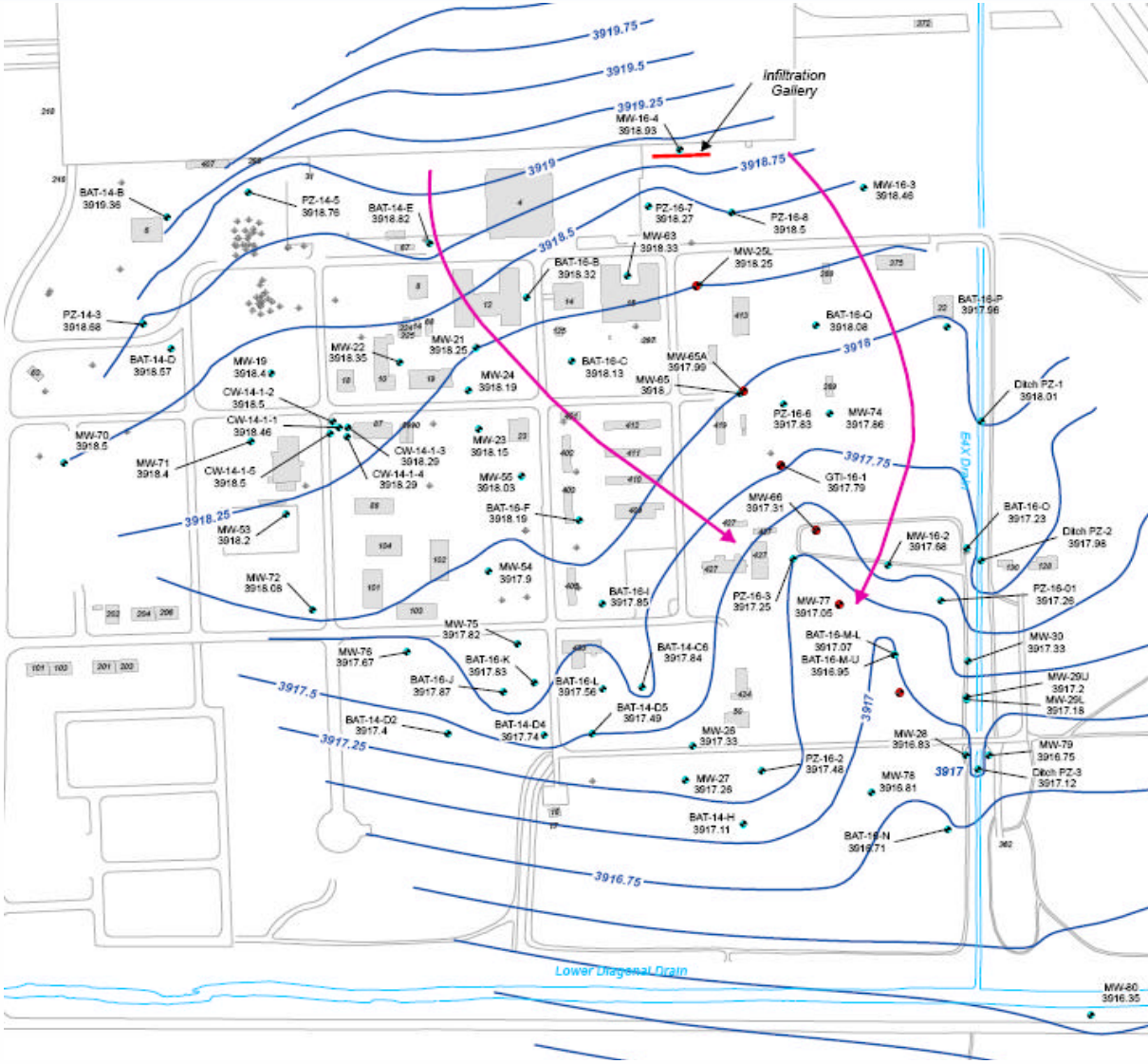
Site 16 Groundwater Flow (pumping conditions – October 2006)

- Despite minor drawdown and mounding, the plume containment system significantly affect flow direction and velocity
- The capture zone of RW-16-1 is large, other wells are insignificant
- Mounding caused by the infiltration gallery increases velocity to 50 feet per year

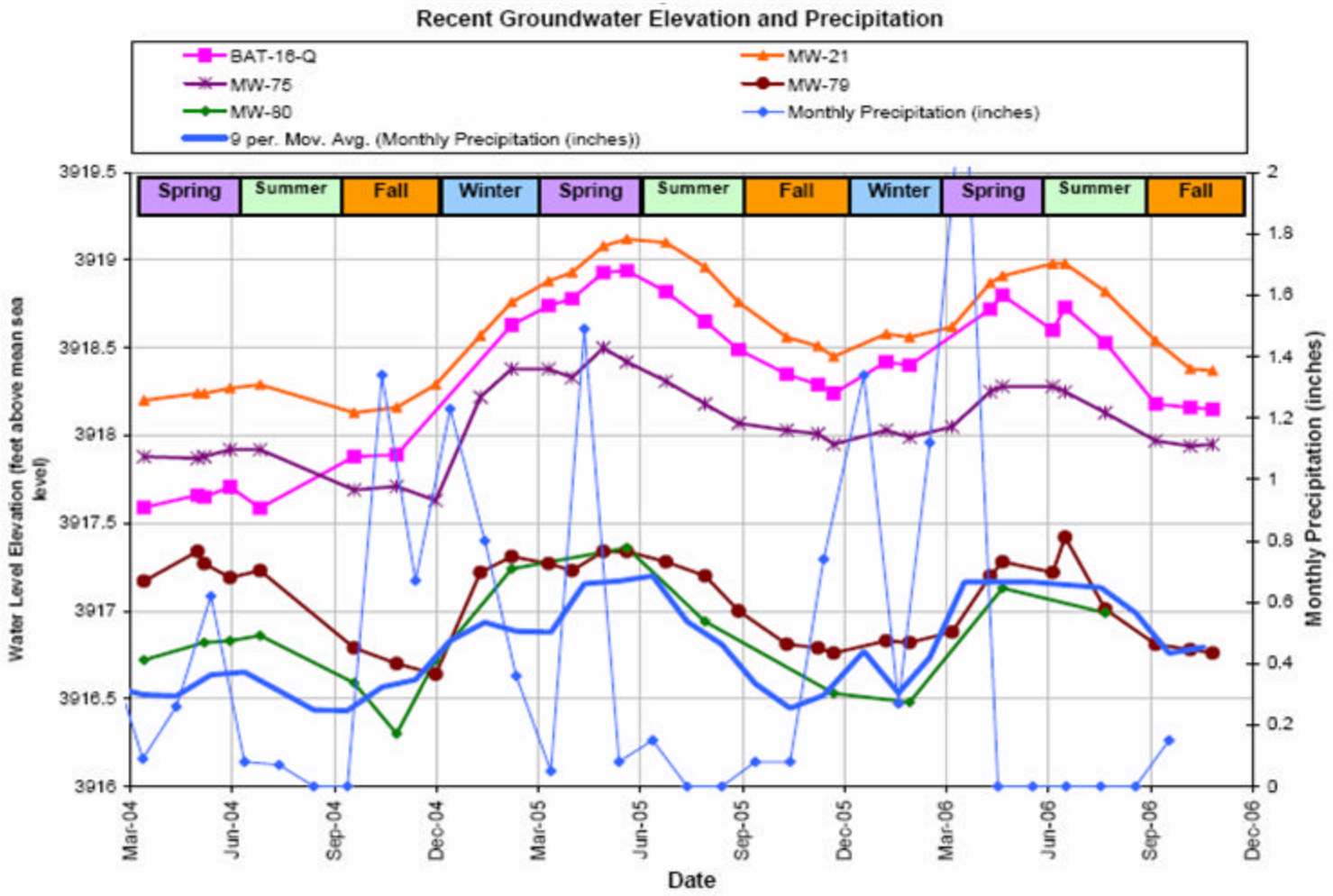


Site 16 Groundwater Flow (natural conditions -- 2007)

- Groundwater levels in January 2007—after system shutdown
- Groundwater level contour map is very similar to June 2004 pre-pumping conditions

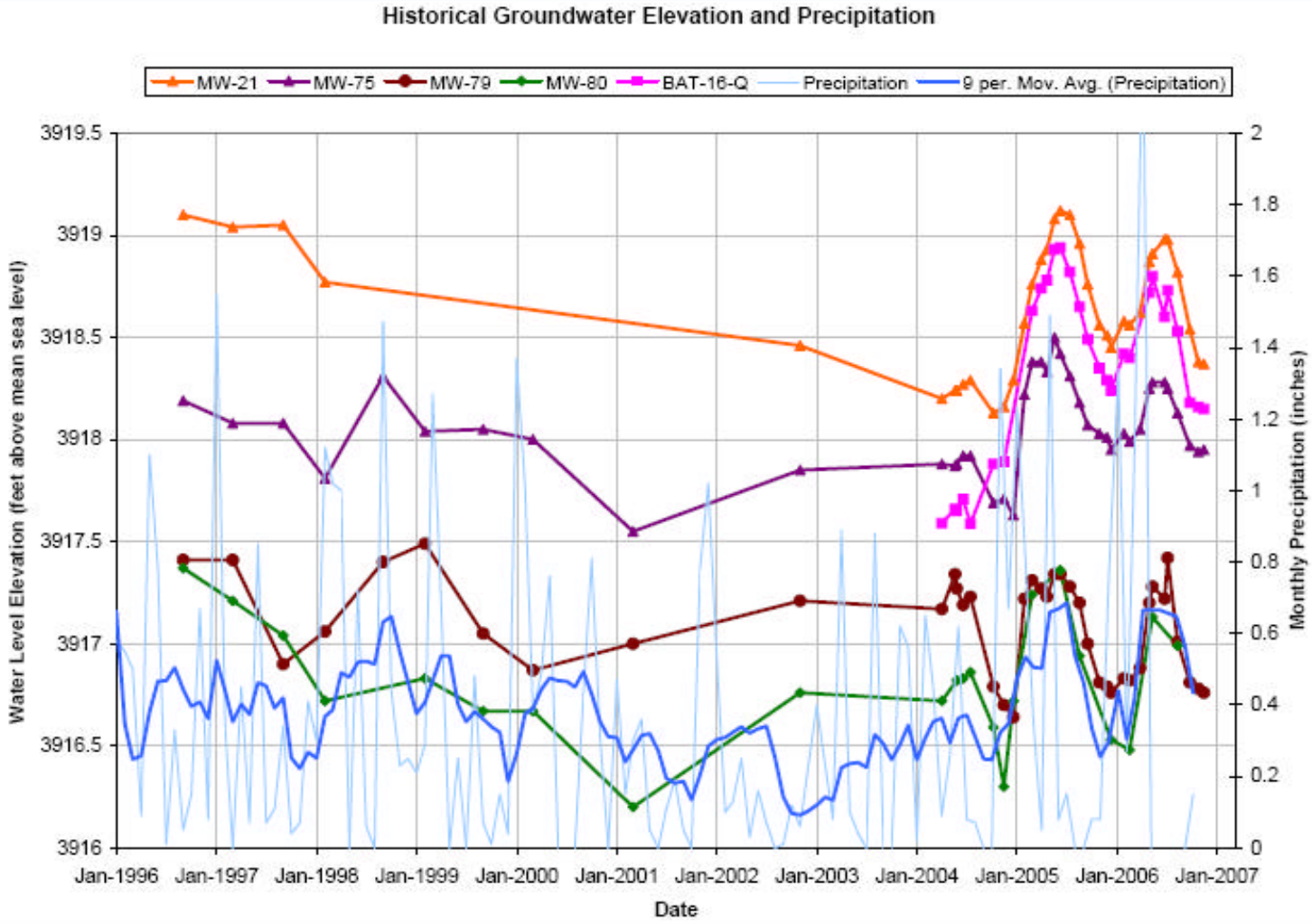


Effect of Precipitation on Groundwater Elevation



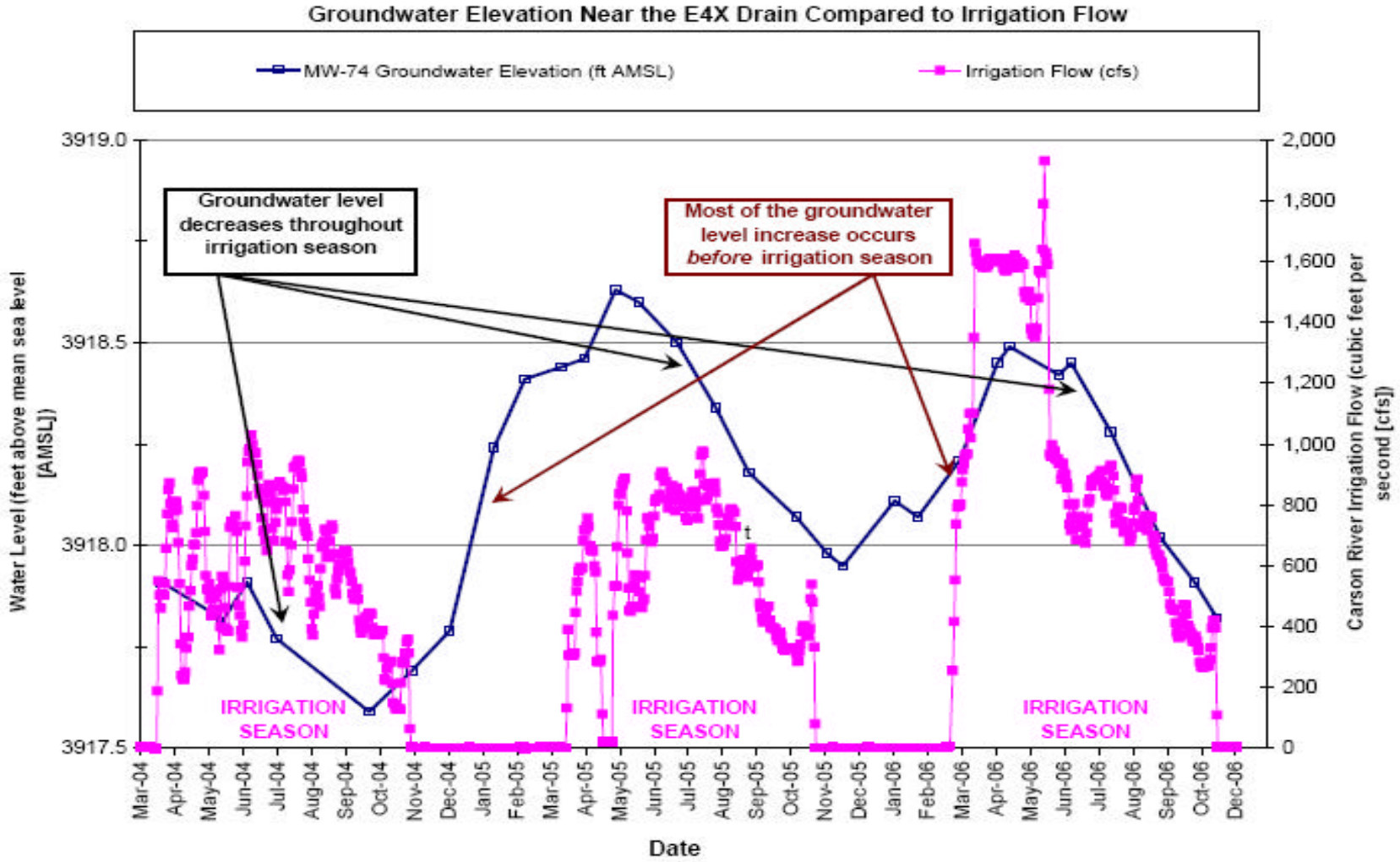
➢Precipitation appears to be the primary cause of groundwater level fluctuations

Historical Groundwater Levels



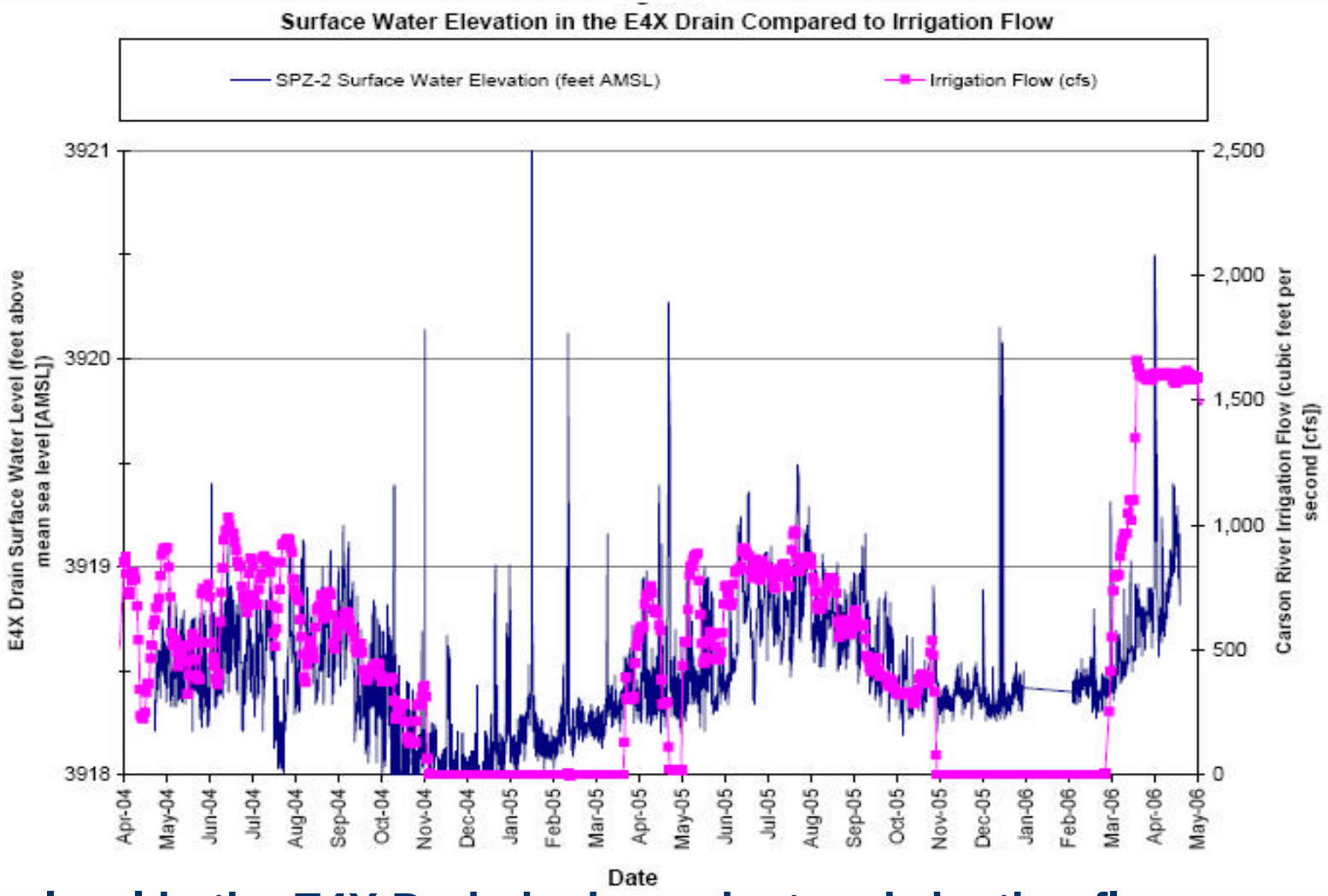
➢Groundwater levels at Site 16 have changed less than 1 foot in the past 11 years

Effect of Irrigation on Groundwater Levels



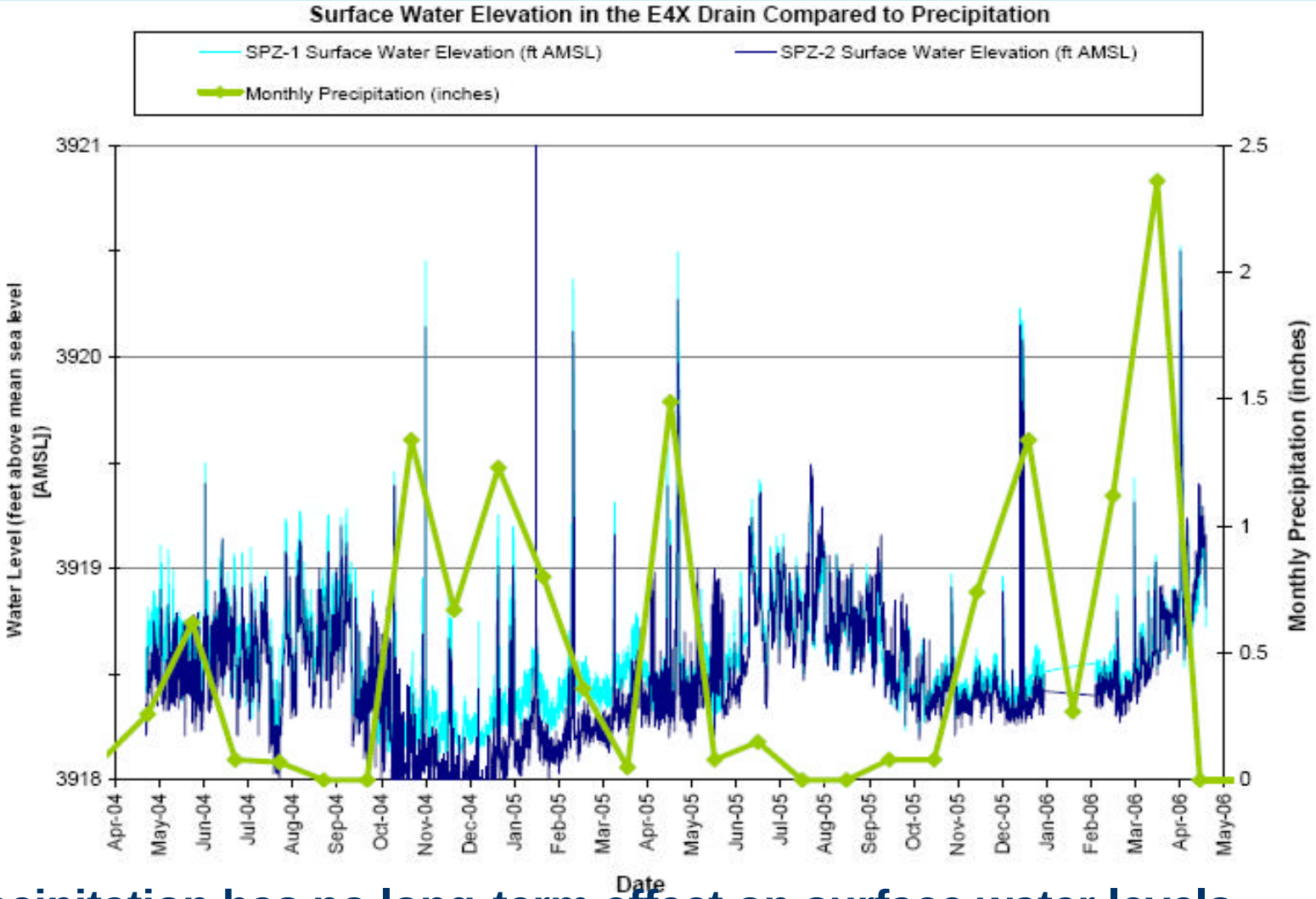
➢Irrigation plays a minor role in seasonal groundwater level fluctuations

Effect of Irrigation on Water Level in E4X Drain



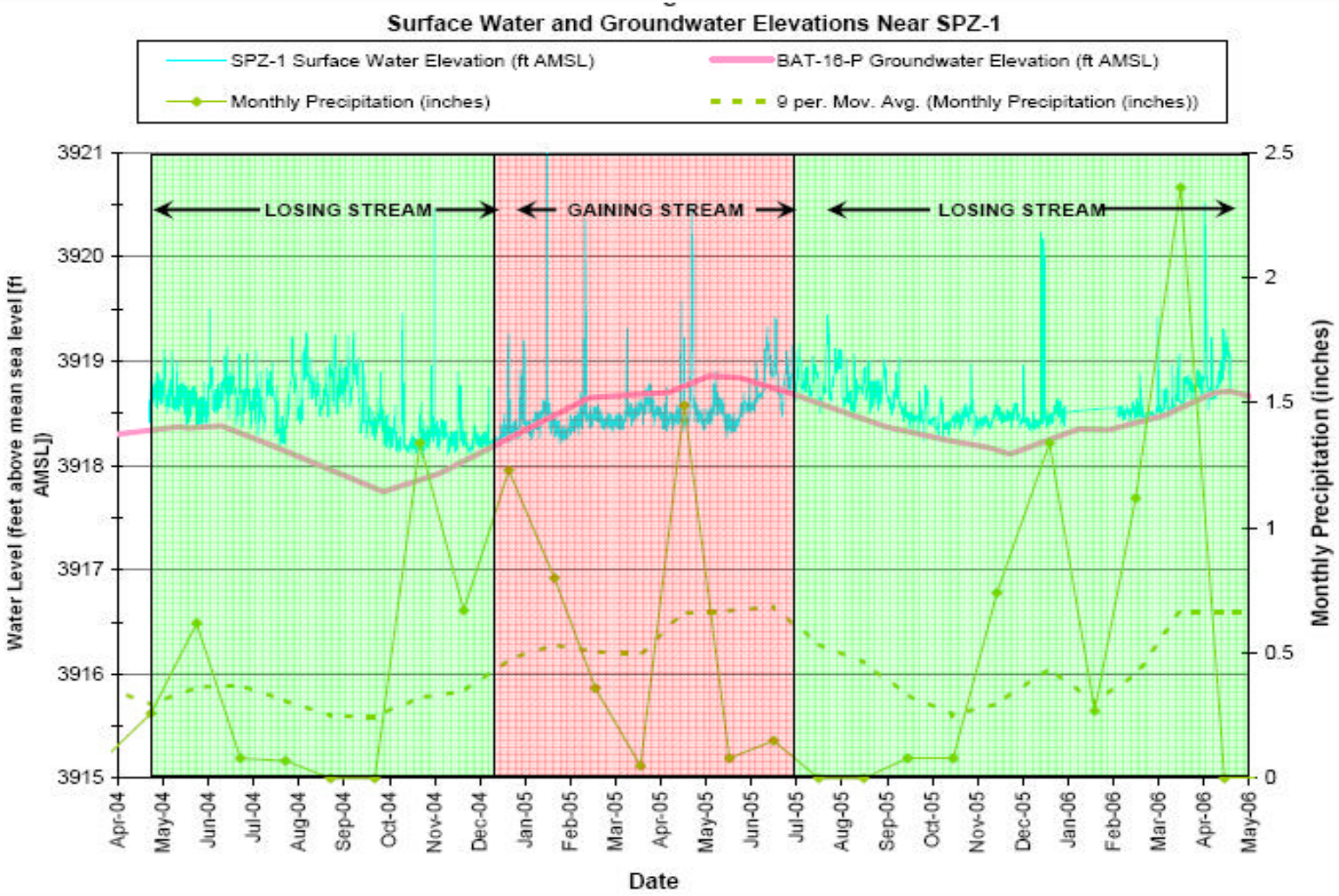
- Water level in the E4X Drain is dependent on irrigation flows

Effect of Precipitation on E4X Drain Water Level



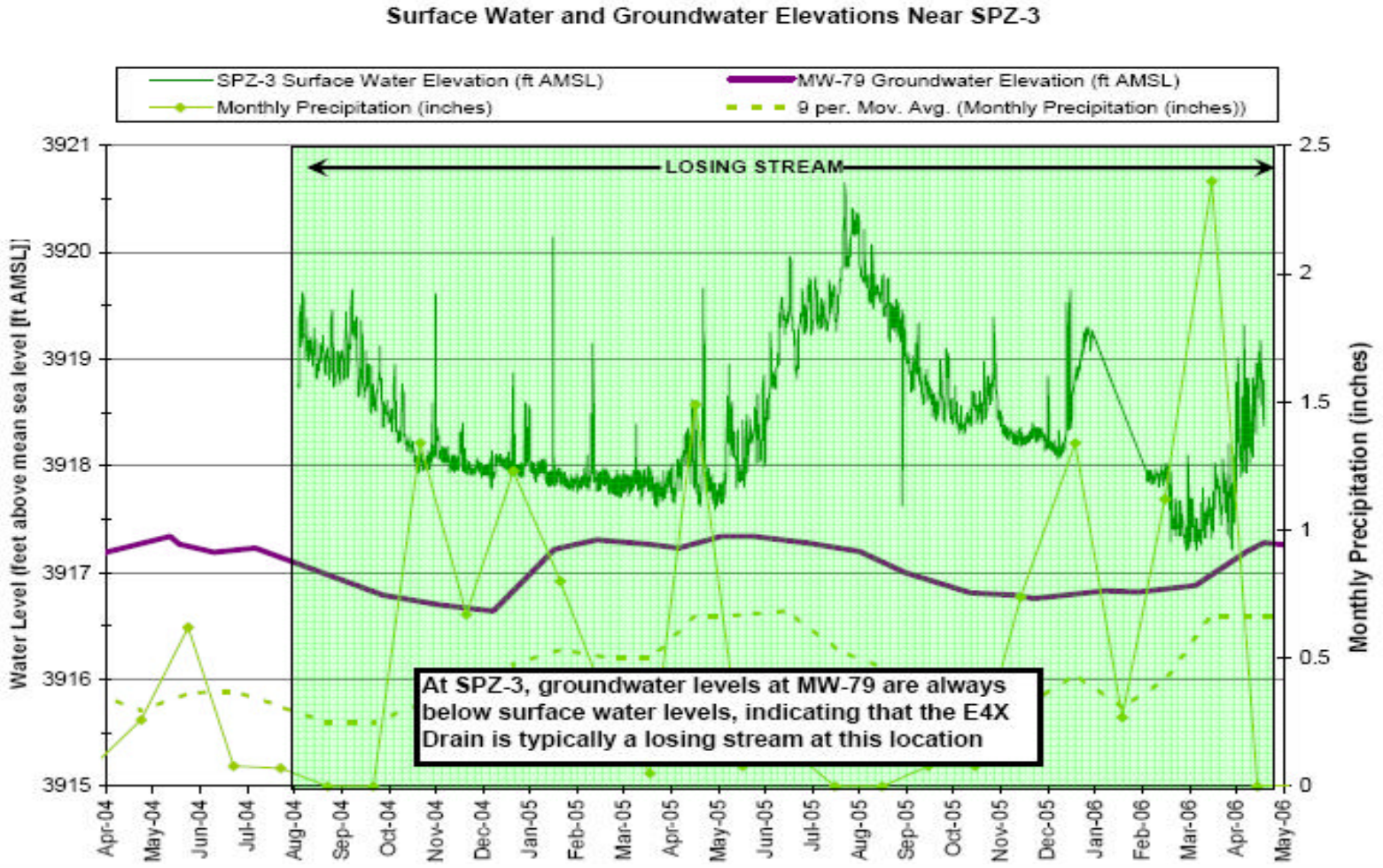
- Precipitation has no long-term effect on surface water levels

Groundwater/Surface Water Levels in Northern Portion of E4X Drain



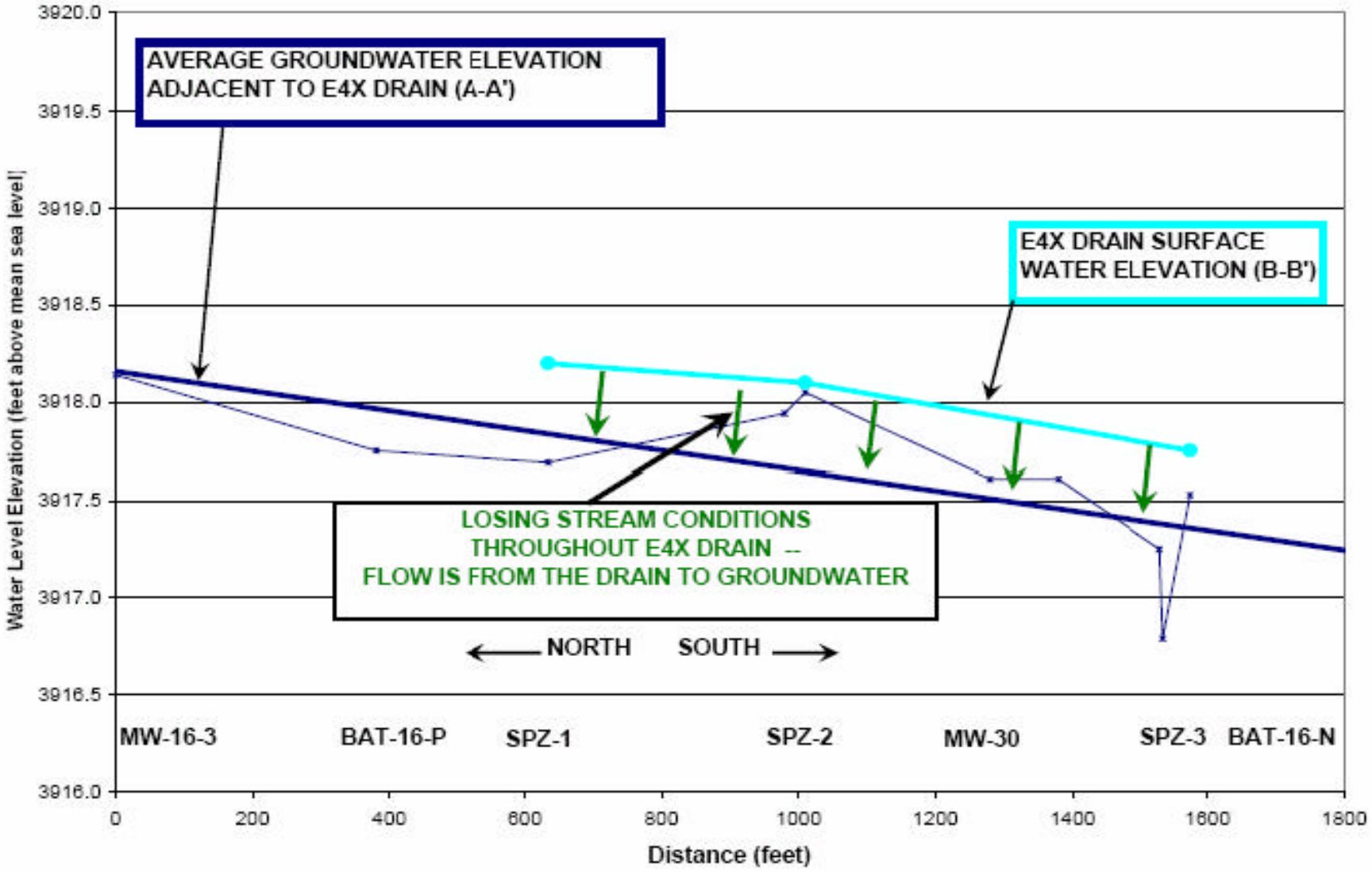
➢In the wet season (winter-spring), groundwater level rises above surface water level

Groundwater/Surface Water Levels in Southern Portion of E4X Drain

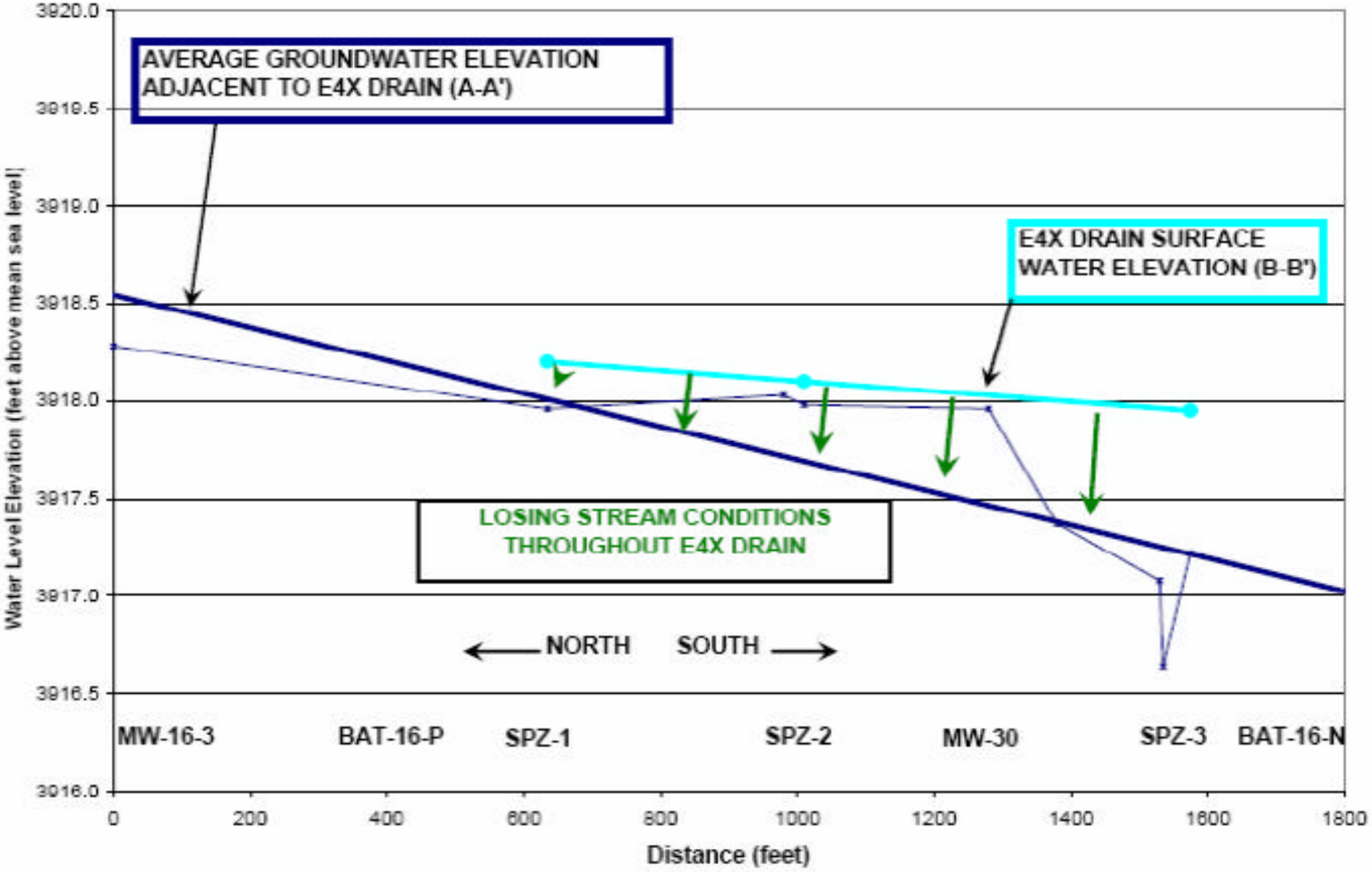


➢**Because of lower groundwater elevation in the area, the southern portion of the E4X Drain is always a losing stream**

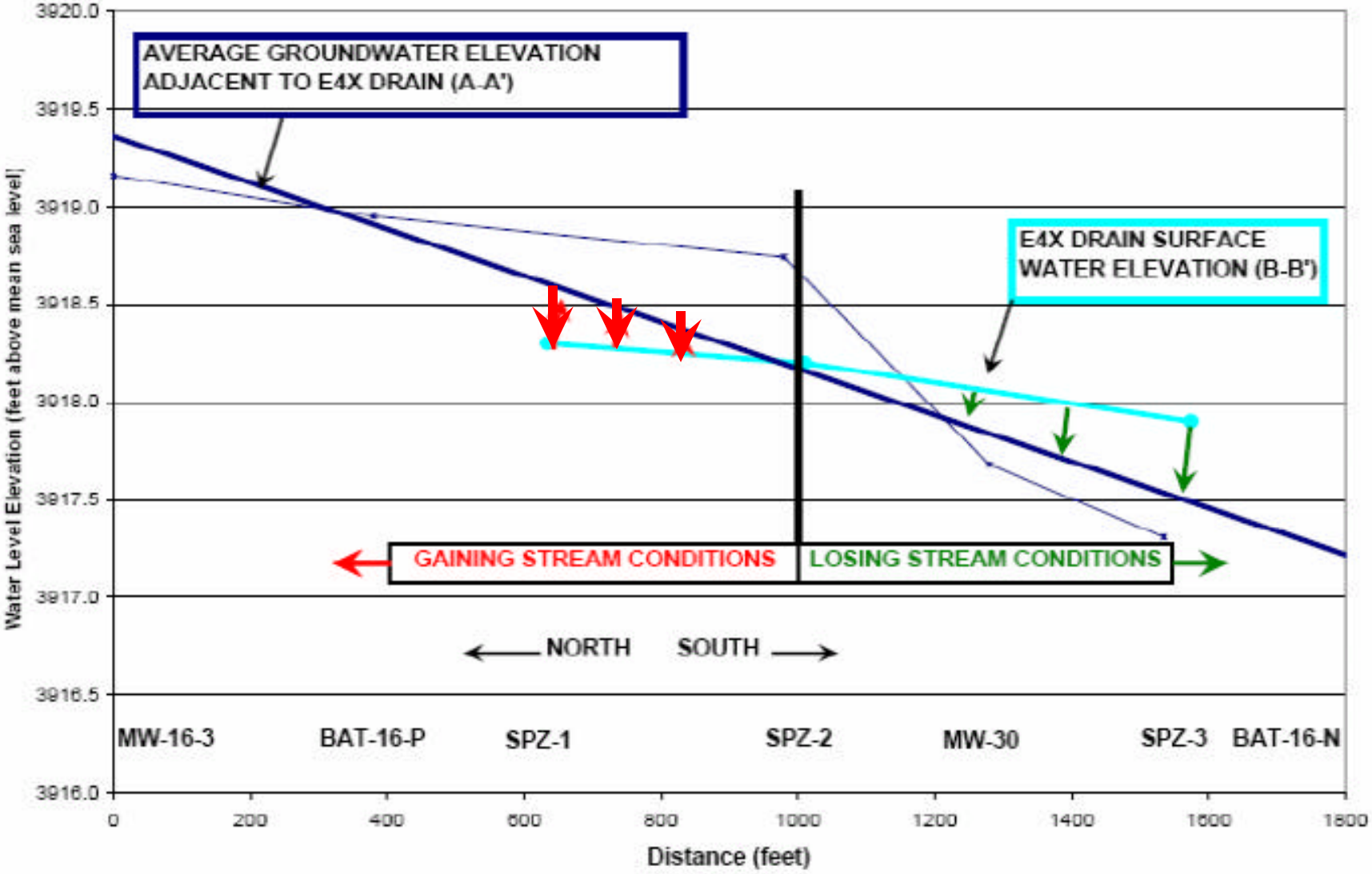
October 2004 – Losing Conditions



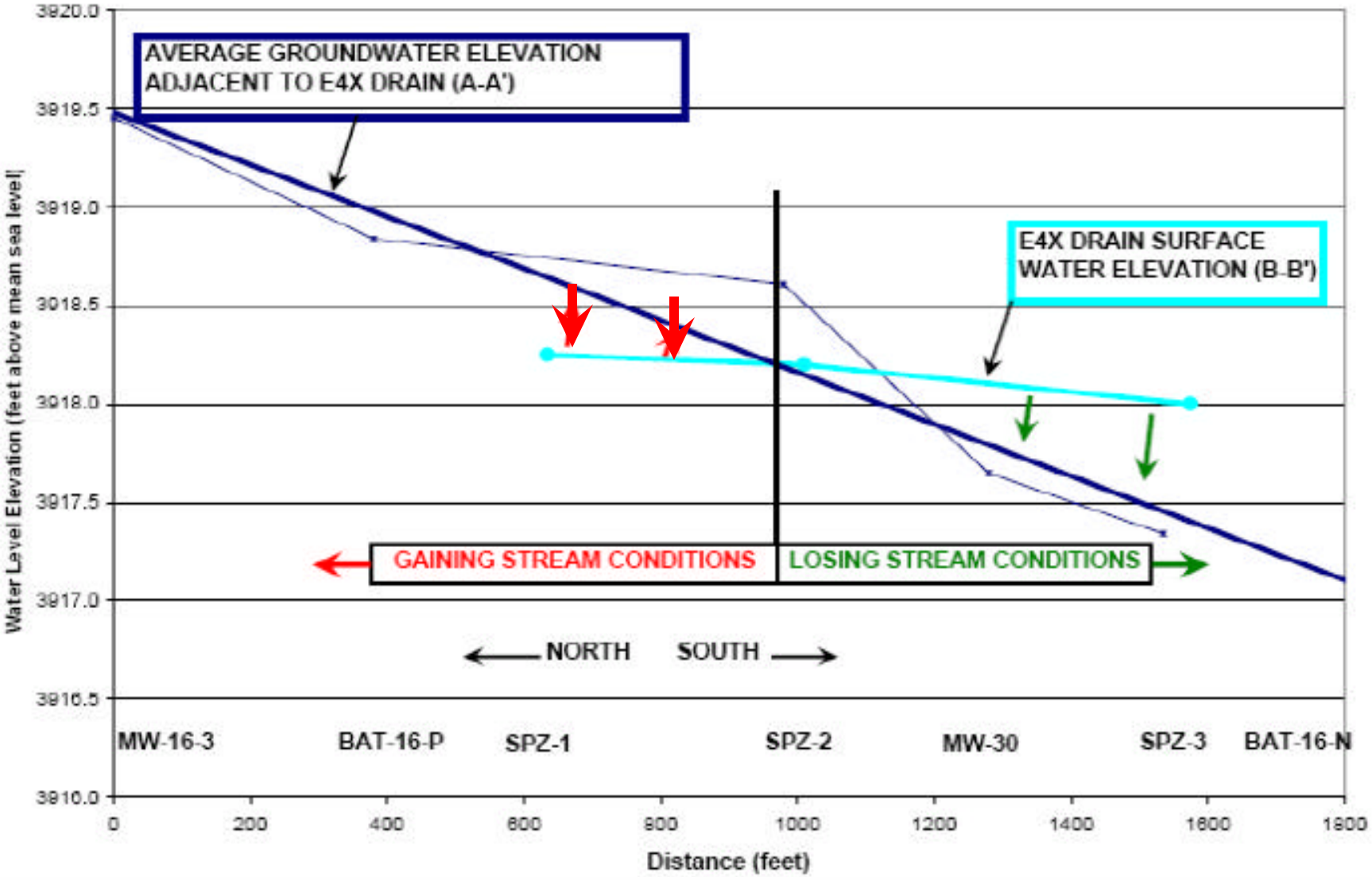
December 2004 – Losing Conditions



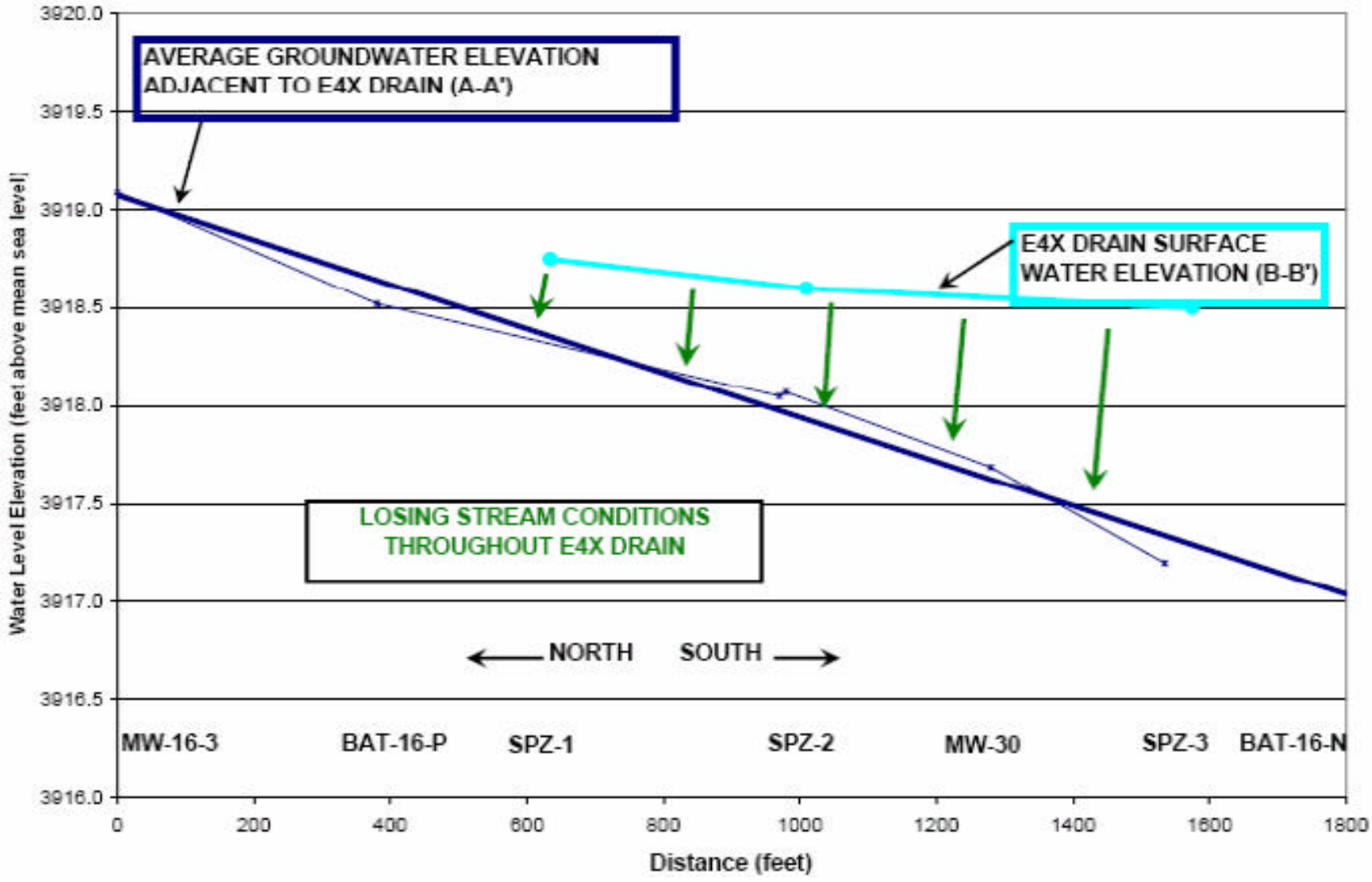
February 2005 – Gaining Conditions



June 2005 – Gaining Conditions



July 2005 – Losing Conditions



What Does it all Mean?

- The system's capture zone mostly captures contamination in the area where the E4X Drain is a losing stream

- The system's capture zone does not fully capture contamination in the area where the E4X Drain is sometimes a gaining stream

- The infiltration gallery increases groundwater velocity in the area of the chlorinated solvent detections (MW-16-3 and BAT-16-P), possibly mobilizing contaminants toward the E4X Drain -- in an area where it is sometimes a gaining stream

- The short-term threat of a significant release of contaminants from Site 16 to the E4X Drain is minor

Therefore, the existing plume containment system does little to prevent contaminants from entering the E4X Drain and should be shut down while more cost-effective remedial options are investigated and implemented

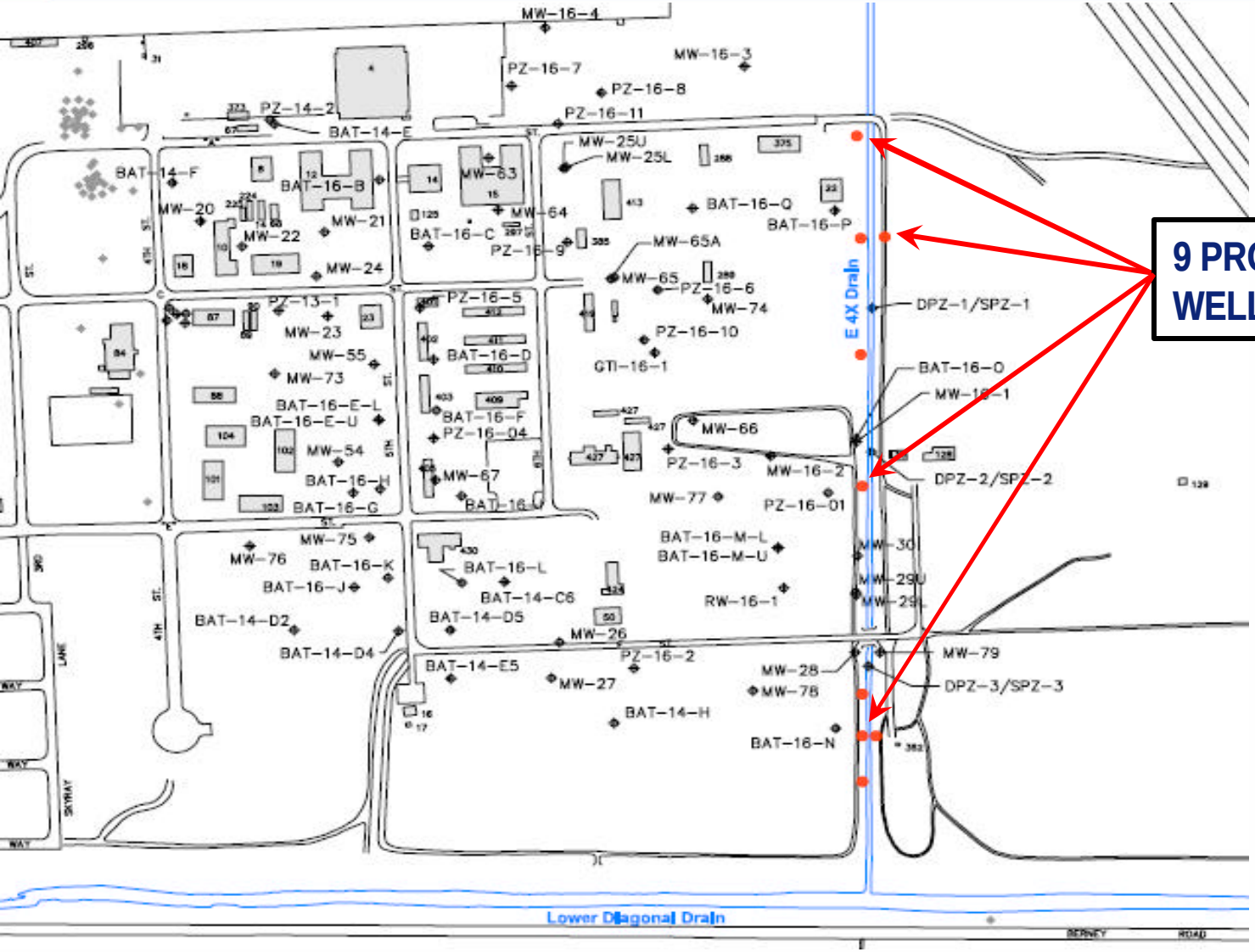
Interim Measures to Monitor and Prevent a Release

- **Install 9 new monitoring wells adjacent to the E4X Drain to**
  - **(1) monitor for groundwater contaminant migration**
  - **(2) delineate groundwater plume(s)**
  - **(3) improve understanding of groundwater/surface water interaction**

- **Install velocity sensors to improve understanding of groundwater flow direction and velocity in vicinity of E4X Drain**

- **Delineate the extent of the chlorinated solvent plume at northern portion of site**

Proposed Locations of New Monitoring Wells



9 PROPOSED SENTRY WELL LOCATIONS